

What is claimed is:

1. A method of forming a doped polycrystalline silicon gate in a Metal Oxide Semiconductor (MOS) device formed on a top surface of a crystalline silicon substrate comprising:

a) forming an insulation layer on said top surface of the silicon substrate;
b) forming an amorphous silicon layer on top of and in contact with said insulation layer;
c) introducing a dopant in a top surface layer of said amorphous silicon layer;

and
d) irradiating said top surface layer of said amorphous silicon layer with a radiation beam to heat said top surface layer and initiate explosive recrystallization of said amorphous silicon layer thereby transforming said amorphous silicon layer into a polycrystalline silicon gate and distributing said dopant uniformly throughout said polycrystalline gate.

2. The method of claim 1 wherein said dopant is introduced in the top layer of the amorphous silicon layer by ion implantation.

3. The method of claim 1 wherein said radiation beam is a laser beam.

4. The method of claim 3 wherein said laser beam is a pulsed laser having a wavelength of between 0.1 and 2.0 microns, a temporal pulse width of less than 1 ms, and an irradiance between 0.1 and 1000 J/cm² per pulse.

5. The method of claim 4 wherein said laser beam comprises between 3 and 10 pulses at a repetition rate between 200 and 400 Hz.

6. The method of claim 1 further comprising after step d) depositing a metal contact atop said polycrystalline gate.

7. The method of claim 6 wherein said metal contact comprises at least one of tungsten, tungsten silicide, tungsten nitride, tantalum, tantalum nitride, titanium, titanium nitride and platinum.

8. The method of claim 1 wherein said insulation layer comprises silicon dioxide.

9. The method of claim 1 wherein said dopant comprises at least one of boron, BF_2^+ , indium, arsenic, phosphorus and antimony.

10. The method of claim 1 wherein said polycrystalline gate has a height of less than 500 nanometers.

11. A method of forming a doped polycrystalline silicon gate in a Metal Oxide Semiconductor (MOS) device formed on a top surface of a crystalline silicon substrate comprising:

- a) forming an insulation layer on said top surface of the silicon substrate;
- b) forming an amorphous silicon layer on top of and in contact with said insulation layer;
- c) forming a dopant layer on top of and in contact with said amorphous silicon layer; and
- d) irradiating said amorphous silicon layer with a radiation beam to heat and melt said dopant layer and a top surface layer of said amorphous silicon layer thereby causing diffusion of said dopant into said top surface layer of said amorphous silicon layer and explosive recrystallization of said amorphous silicon layer thereby transforming said amorphous layer into a polycrystalline silicon gate and distributing said dopant uniformly throughout said polycrystalline gate.

12. The method of claim 11 wherein said dopant layer is formed via sputtering.

13. The method of claim 11 wherein said dopant layer is formed via chemical vapor deposition.

14. The method of claim 11 wherein said dopant layer is formed via evaporation.

15. The method of claim 11 wherein said radiation beam is a laser beam.

16. The method of claim 15 wherein said laser beam is a pulsed laser having a wavelength of between 0.1 and 2.0 microns, a temporal pulse width of less than 1 ms, and an irradiance between 0.1 and 1000 J/cm² per pulse.

5 17. The method of claim 16 wherein said laser beam comprises between 3 and 10 pulses at a repetition rate between 200 and 400 Hz.

18. The method of claim 11 further comprising after step d) depositing a metal contact atop said polycrystalline gate.

10 19. The method of claim 18 wherein said metal contact comprises at least one of tungsten, tungsten silicide, tungsten nitride, tantalum, tantalum nitride, titanium, titanium nitride and platinum.

15 20. The method of claim 11 wherein said insulation layer comprises silicon dioxide.

20 21. The method of claim 11 wherein said dopant comprises at least one of boron, BF₂⁺, indium, arsenic, phosphorus and antimony.

25 22. The method of claim 11 wherein said polycrystalline gate has a height of less than 500 nanometers.

30 23. The method of claim 11 wherein said dopant comprises at least one of boron, arsenic, phosphorus at concentrations of up to 3X10²⁰ ions/cm³, 5X10²⁰ ions/cm³, and 1X10²¹ ions/cm³, respectively.